

Burnett (Swan M.)

ON THE REFORM IN NUMBERING PRISMS.

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BY SWAN M. BURNETT, M.D., PH.D.,
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SOME time ago I had the opportunity of seeing a manuscript submitted for publication which dealt with a new method of designating anomalies in the refraction of the eye. The system consisted essentially in the adoption of a varying index of refraction in the media as expressive of the varying refracting power. The points were well taken, the argument was logical, scientific, and conclusive; but I do not believe the system ever came, or is likely to come, into general use, for reasons which are too apparent to require mention.

When I first saw the proposition to use what is called the centrad as a method of designating prisms, this ingenious system of marking ametropia instantly came into my mind, probably because of its analogous cleverness and ingenuity. For I hasten to say that the centrad *is* an ingenious conception, as are all the conceptions which originate with Dr. Dennett; and as a work of ingenuity I admire it as much as anyone can. But in this work-a-day world, where we have to deal with only average intelligences, and where prejudices of tradition and custom and the inertia of established

habit are the greatest obstacles we have to advancement in all lines of scientific study and work, any radical innovation which requires a reeducation from the very foundation can hope for success only when it possesses a practical advantage over all competitors, which can be easily demonstrated to the most ordinary comprehension. That, in my opinion, the centrad does not possess such advantage in the numbering of prisms I have stated in my paper in the January number of the *Ophthalmic Review* and given my reasons therefor. Those interested in the question I would refer to the paper itself as expressing in general the arguments which I conceive to be valid against it and the minimum angle of deviation, and those in favor of the prism-dioptry.

The object of this present communication is to reply as briefly as possible to some strictures on that article, made by Dr. Randall in the issue of THE MEDICAL NEWS for April 4th.

Among other things, he says: "The prism-dioptry, which is a tangent measurement, declines in value with each increase of the angle." What he should have said, and what he probably meant, is that the tangent, being a growing function, *increases* with the value of the angle until the latter reaches 90° , when the tangent is *infinitely great*. There is nothing that is absolutely contrary to the truth in that simple proposition, but it has the defect of not telling the whole truth. He makes the mistake of assuming that we are compelled to regard the deflection caused by a prism on a plane at any given distance in the light of a tangent. Now, as I have stated in the paper referred to, we are compelled to

do nothing of the kind. We can, without surrendering any scientific principle, regard the deflection as a displacement, measurable in a linear manner on this plane, without regarding its reciprocal as expressed in sine, tangent, co-sine, co-tangent, degree, minute, or second, or in any other way that may be fancied. The absolute difference, however, between the multiples of the sine, tangent, and arc, for even a prism of 10° , which is higher than is, or should be, used in practice, is really insignificant :

Tang. $1^\circ = 0.01745$.	Arc $1^\circ = 0.01745$.	Sin. $1^\circ = 0.01745$.
Tang. $(10 \times 1) 10^\circ = 0.17633$.	Arc $(10 \times 1) 10^\circ = 1.745$.	Sin. $(10 \times 1) 10^\circ = 0.017365$
Diff. = 0.000183 less.	No difference.	Diff. = 0.00085 more.

How simple and easy it is to explain to even the uninitiated that a No. 1 prism is one which causes a deflection of one centimetre on a plane at a distance of one metre ; No. 2, two centimetres ; No. 3, three centimetres, and so on. That represents exactly and truly the amount of work done by the special prism so designated, and that is precisely what we want to know. We care nothing, practically, about its reciprocals expressed in angles, any more than in co-sines or co-tangents ; and yet we can find these if, from curiosity or for scientific reasons, we so desire, from the ordinary table of sines, co-sines, etc., just as we now have to find these reciprocals from the angle. And the fact that the angle of twenty prism-dioptres is not exactly twenty times the angle of one prism-dioptre is a matter of no practical consequence whatever, because we have not, nor need we have, anything to do with angles, any more than when we are dealing with spherical

and cylindrical lenses—which, after all, are only series of prisms of constantly-varying deflection.

What is our standard for refracting lenses? One which causes a deflection of all parallel rays to a point on a plane at a metre's distance. What should be our standard for prisms in harmony with this? Naturally, one which causes a certain deflection at the metre plane; and what more appropriate and in keeping with our accepted standard of linear measurement than to have this unit deflection one centimetre? This is in consonance with the C. G. S. system, which is assumed as the basis of the centrad. The prism-dioptre is not only strictly scientific and exact in what it professes to do, namely, to give the deflecting power of any given prism, but it is marvellously simple in principle, is in perfect harmony with the metric system of numbering spectacle lenses, and is easily practised by anyone having a metre measure and a centimetre scale.

We are taken to task by Dr. Randall, because we asserted that neither Dr. Dennett nor any of the advocates of the centrad had offered any practical method of measuring the power of prisms according to the radian system. He says: "Dr. Burnett has befogged himself by importing into the centrad system the 'minimum deviation,' which has no place there. Like the prism-dioptre, the centrad is a prism which at one metre distance deflects the ray of light falling at right angles upon one of its faces through the space of one centimetre, the only difference being that the centrad is measured on the arc and not on the tangent."

When we read that paragraph we wondered if Dr.

Randall had re-read Dr. Dennett's original paper recently and was aware of what Dr. Dennett actually proposed in his centrad system. Dr. Dennett says nothing at all about measuring one centimetre on the arc at the metre's radius. He expresses his unit only in reciprocal angles, and says: "We define the ideal centrad as an achromatic prism that produces in light passing through it in a direction perpendicular to one of its faces a deviation of one one-hundredth of a radian, or 0.57295° ." This was the basis of our remark that the centrad could not perform any function which was not now equally well performed by the minimum angle.

Those of us who advocate prism-dioptre are glad to have its principles acknowledged and accepted, but not exactly in the way Dr. Randall has done. To Mr. Prentice alone belongs the credit of having proposed as a standard prism one which produces a deflection of one centimetre at one metre's distance, and no advocate of the centrad ever hinted at it until after the appearance of Mr. Prentice's paper in the *Archives of Ophthalmology*. We owe the simplicity of that idea to Mr. Prentice; let us not deprive him of whatever honor belongs to the conception. But if the advocates of the centrad desire to abandon their original idea of the reciprocal angle and will accept the curvilinear deflection of one centimetre at a metre's distance as a basis of numbering, the difference in principle between that and the prism-dioptre would not be great. The difficulty, however, as was foreseen by Mr. Prentice

and myself, is that the curvilinear measure is not so easily or readily made as the purely linear, and the practical advantage we saw was greatly in favor of the latter. It is so much easier to measure deflections on a plane than on a curve.

We would like to enter here into more detailed consideration of the relation of the prism-dioptre to the metre-angle, but as Dr. Randall has acknowledged the great practical value of Mr. Prentice's work in that particular, we will defer its discussion for a future paper, in which we hope to show how the whole matter of convergence can be made simpler and more easily studied by means of the prism-dioptre than it is now by means of the clumsy metre-angle.

In the decentring of lenses the prism-dioptre system shows up to the greatest possible advantage, as has been demonstrated thoroughly by Mr. Prentice in his paper in the *Archives of Ophthalmology*. In regard to this Dr. Randall naïvely remarks: "I question if this be correct, although I fail to detect any fault in the argument."

When he does we trust he will let us know.

Dr. Randall's desire to make the centrad supercede the angle in measuring strabismus and in designating the direction of the axes of cylinders we cannot but regard as vain, knowing as we do the antipathy to change from even a bad system already established in the working of an art, although it be a scientific one, which prevails in the minds of the profession at large; when the reform comes, we fancy it will not be in the line of the centrad.

We quote, finally, this Parthian shot: "Dr. Burnett's assumption that the centrad is indivisible, and

THE REFORM IN NUMBERING PRISMS. 7

that only exact whole numbers can be employed, is gratuitous, to say the least."

Dr. Burnett never entertained any such opinion, and is not able to find any expression pointing to such an opinion in anything he has written on the subject.

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